II. *Optical Experiments made in the Beginning of* Auguſt 1728, *before the Preſident and ſeveral Members of the Royal Society, and other Gentlemen of ſeveral Nations, upon Occaſion of Signior* Rizzetti'*s Opticks, with an Account of the ſaid Book, By* J. T. Deſaguliers, *L L. D. and F. R. S.*

SOme Time in the Year 1722, Signior *Gizlanzoni*, an *Italian* Gentleman, ſhew'd me a Paper of Signior *John Rizzetti*, wherein he denied the different Refrangibility of the Rays of Light, becauſe an Experiment mentioned in Sir *Iſaac Newton*'s Opticks (B. 1. *Prop*. 1. *Exp*. 2.) concerning an oblong Paper painted half blue and half red (whoſe Image projected by a Lens upon a white Paper at a conſiderable Diſtance became diſtinct in its blue half, nearer the Lens than in its red half) had not ſucceeded with him, tho' after many Trials. Sir *Iſaac Newton* being acquainted with this, deſired me to repeat his Experiment abovementioned, which I did at my own Houſe, before him and Signior *Gizlanzoni* and ſome other Perſons, who were ſatisfied with the Succeſs of it, according to Sir *Iſaac Newton*'s Aſſertion. Afterwards on the 13th of *December* 1722, I again repeated the Experiment before the *Royal Society*, with the ſame Succeſs, the full Account of which is printed in the *Philoſophical Tranſactions*, Number 374. After this, Signior *Gizlanzoni* read me a Letter from Signior *Rizzetti*, wherein he ſaid; " He wanted to know whether the " Expe-

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Experiment would ſucceed, if the Paper was turned ſo as to bring the red Half in the Place of the blue one; and that if it ſucceeded then, yet he would not acquieſce, but he ſhould have ſomething ſtill to object againſt it. And further, that he wanted to know what could be ſaid to ſeveral other Objections (I think there were twelve in the Paper ſhewed me) againſt many more of Sir *Iſaac Newton*'s Optical Experiments, the greateſt Part of which he ſaid, he had found to ſucceed differently from what Sir *Iſaac* had related; and would not allow the Conſequences to be juſt, which were drawn from the other Experiments which he had found to agree with his Trials". Upon this I acquainted Signior *Gizlanzoni* in a Letter, which I deſired him to communicate to Signior *Rizzetti*; "that as Signior *Rizzetti* had put the Iſſue of the Diſpute upon the Succeſs of an Experiment, which after repeated Trials had ſucceeded contrary to his Opinion, he ought to acknowledge his Miſtake; and then I ſhould willingly repeat all the other Experiments which he had called in Queſtion, and endeavour to remove his other Difficulties. That if it was Truth and not Victory which he contended for, I did not doubt but he would comply with me, in what I inſiſted upon; and then I ſhould be ready to make any Experiment, or clear up any Difficulty relating to the Doctrine of Colours, in the beſt manner I could". But I never heard any more from Signior *Rizzetti*; but was told by others that he was very angry at Signior *Gizlanzoni*, and ſaid he was got into Sir *Iſaac Newton*'s Party.

Now at laſt Signior *Rizzetti* has publiſhed a Book, entituled *De Luminis Affectionibus Specimen Phyſico-mathematicum*,

mathematicum, dedicated to Cardinal *Polignac*, and printed at *Treviſe* and *Venice*, 1727, which being preſented to the *Royal Society*, and by the Society recommended to me to give an Account of it, I hope no Body will blame me for making a faithful Report.

The Author in his Preface, and throughout the whole Book, in a moſt arrogant manner, has inſulted the greateſt Philoſopher that this or any other Age ever bred, triumphing in what he thinks the Miſtakes of Sir *Iſaac Newton* and his own Diſcoveries. Had he modeſtly related the Facts as they appeared to him, and his Reaſons for drawing Conſequences different from thoſe of Sir *Iſaac Newton*, the World might have thought him urged on by the Love of Truth in his *ten Years Labours*,* and his Errors might have been excuſed according to what he ſays in his Preface *Si fortè decipior, haud turpis eſt in re Phyſico-mathematica error, & magnis ſe quiſque tuetur exemplis.* Neither would his Fame have been the leſs (if he had been right in his Experiments and Reaſonings) for treating his Adverſaries in a civil Manner, and really doing what he ſays at the End of his Preface "*Placita* "*quidem authorum laceſſo; at ipſos tamen authores* "*obſequio & veneratione proſequor*": For ill Manners can never be excuſed by what he calls *Philoſophica Libertas.* Now nothing leſs than owning, *that a greedy Deſire of Fame, and an Obſtinacy to maintain what he once laid down as his Opinion, miſled him ſo far, can excuſe him to the learned World.* We hear indeed in a Letter from Sir *Thomas Dereham* to Sir *Hans Sloane*, Preſident of the *Royal Society*, that *now* Signior *Rizzetti* alledges, " That he was

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* See Preface, p. 38.

" deceived in his Experiments, by Reaſon of the Bad-
" neſs of his Priſms which he had from *Venice*" ; but this is but a partial Acknowledgment of his Error, and only ſatisfactory to ſuch as have not read his Book, and are likewiſe unacquainted with Sir *Iſaac Newton*'s Opticks. For Signior ***Rizzetti*** in the 37th and 38th Pages of his Preface has theſe Words—" *Ut ſuoſmet*
" *oculos conſulant, omnes quidem poſſunt mea Ex-*
" *perimenta iterare; at ſi primo intuitu deficit, qui*
" *expectatur, eventus; ſtatim me falſitatis non ar-*
" *guant (ut vir celebris dicitur nimia feſtinatione*
" *feciſſe); ſed prius omnes meorum experimentorum*
" *limitationes notent: Si ad has enim attenderint;*
" *non pingui Minerva, non trigonis imperfectis [ut*
" *alii dictitant] ſed accurata diligentia, & inſtru-*
" *mentis idoneis me in hujuſmodi res incubuiſſe etiam*
" *adverſarii, vel inviti fatebuntur*". As to Sir *Iſaac Newton*'s Experiments, a great many of thoſe which Signior ***Rizzetti*** calls in Queſtion may be performed with very ordinary Priſms: And of that Sort are thoſe which I made ſince the Publication of the Book in the Beginning of laſt *Auguſt*, at my own Houſe, before the Preſident and ſeveral Members of the *Royal Society*, and ſome foreign Gentlemen. But before I give an Account of the Experiments, I beg Leave to quote ſome of Signior ***Rizzetti***'s Expreſſions againſt Sir *Iſaac Newton*, otherwiſe I may be thought guilty of the very Fault which I have laid to his Charge.

Preface, Page 13. " *Miratus ſum quod acutiſſimus*
" *Newtonus ignoraverit Lumen album aliter a*
" *Trigono, & aliter a lente diſpergi.*" Who ever read Sir *Iſaac Newton*'s Opticks, that can be of this Opinion, except our Author? Preface, Page 81.—
" *Theoria*

“*Theoria in qua tot Hypotheſes ſunt, quot explicanda Phænomena*”. When it is well known that Sir *Iſaac Newton* did not make Hypotheſes to explain, but deduced plain Conſequences from *Phænomena.* In the Book, Page 55 he ſays of *Richterus* his Adverſary——“*Si diverſam colorum refrangibilitatem garriendo tueri deliberat*”,——and of Sir *Iſaac*——“*Si Newtonus hallucinatus eſt, quia in uno experimentorum genere fallaciis unici ac difficillimi indulſit; nos antequam conſequentias eliciamus, diſcimus omnia ejuſdem generis experimenta peragrare, a facilioribus incipiendo.*” Page 76. ſpeaking of Sir *Iſaac*——“*Nunc igitur confidentius affirmo, quod equidem plures, quam debuerat conſequentias ex Phænomenis auctor collegit.*” Page 90. “*Quis auſiſſet canonem tanti viri impugnare, cum ceſſerunt omnes, qui hactenus eum veluti trutina expenderunt,* &c.” Page 91. “This Expreſſion is particularly remarkable——“*Newtonus hoc argumentandi modo videtur feciſſe ut Lesbii, qui, cum ædes ad Regulam minime accomodarentur, Regulam ad ædes accomodarunt*”.

I cannot paſs by what he ſays of *Richterus* in p. 100, “becauſe it is ſo applicable to himſelf, *Richterum admonui, ut marte ſuo, quod omiſerunt alii perficeret; is autem, ſpreta admonitione, videre quod a natura agatur, ſed eam potius agere vult, quod ſibi videtur agendum.*” Page 127. “*Cum hæc auctor in medium ferat, parum in iis expertus eſſe videtur, quæ in poliendis vitris occurrunt.*”

Not to be tedious in ſuch unpleaſant Quotations, I proceed to give a ſhort Account of the Book it ſelf, to ſhew how much Pains ſome People can take to be in the

Wrong, there being no Experiment of Sir *Iſaac*'s called in Queſtion but what is true, and no Conſequence different from Sir *Iſaac*'s in thoſe Experiments which he found to ſucceed, but what is falſe; as may be evident to any one who reads Sir *Iſaac Newton*'s Opticks with Attention enough to underſtand them ; and has proper Inſtruments and ſufficient Dexterity and Accuracy to perform the Experiments.

Our Author (tho' he profeſſes himſelf an Enemy to Hypotheſes) begins his very firſt Propoſition with a Demonſtration drawn from a falſe Hypotheſis ; for he ſuppoſes every Beam of Light to be as a Parallelogram of ſome Breadth like a Ribbon, as if the Rays cohered together like the longitudinal Threads of the Ribbon ; then conſidering a narrow Side of the Parallelogram (which he calls the Section of the Beam) as an inflexible Line, he takes a great deal of Pains to draw a Conſequence from it, which Experiments ſhew to be falſe ; namely, that Light paſſes with more Difficulty through a denſe, than through a rare Medium. He affirms, " That white Light never affords Colours by Reflexion."

That the Union of all Kind of Rays do not make " *white*."

" That Light reflected from a *white* Object, and ſeen through a dark Medium, becomes *yellow* or *red*, as the Medium is ſtronger or weaker ; that *black* ſeen through a lucid Medium appears *blue* or *violet* ; and *green* he ſays is made from a $\left.\begin{array}{l}\text{black}\\ \text{white}\end{array}\right\}$ Object ſeen firſt thro' a $\left\{\begin{array}{l}\text{lucid}\\ \text{dark,}\end{array}\right\}$ then thro' a $\left\{\begin{array}{l}\text{dark}\\ \text{lucid}\end{array}\right\}$ Medium.

" That ſome Light paſſing through a refracting Medium is diſperſed, which he calls *more than refracted*, and ſo produces Colours."

In order to ſupport his Hypotheſes of *Mediums like Veils to alter the Colours of Objects looked at*, " he " conſiders (Preface, Page 31.) the images in the Eye " as an Object looked at, which would be ſuppoſing " other Organs of Viſion to look into the Eyes"— whereas the Pictures of external Objects ſhewn upon the back Part of an Eye placed in an Hole in the Window of a dark Room, are only ſuch to thoſe who ſee the Experiment; but in the Animal who ſees, thoſe Pictures are a great Number of ſmall Blows or Impreſſions made upon the Fibres of the *Retina* by the Impulſe of many Rays collected in the Vertices of the Cones of Light within the Eye, correſponding with ſo many other Cones which proceed from the viſible Points of external Objects, and make, what Opticians call Pencils of Rays.

" That the Reſiſtance of Water from its Tenacity is " greater than from its Denſity.

" That ſince a ſmall Thread, half *blue* and half *red*, " is ſeen diſtinctly by the naked Eye, that Phænome- " non overthrows the Doctrine of *different Refran-* " *gibility*." But here the Author does not conſider, that the Focus of the Eye is ſo ſhort that the Diſtance of the diſtinct Baſe of the *blue* and the *red* Image of ſuch Threads is not equal to the Thickneſs of the *Retina*.

" That the Experiment of the two-coloured Paper " projecting its Image through a Lens (which I repeat- " ed in the Manner above-mentioned, in the Year " 1722) did ſometimes ſucceed with him, and ſome- " times not; and therefore that it did not prove the dif- " ferent Refrangibility of Rays: But the different " Place of the diſtinct Baſe of the *blue* and the *red* " Image, was to be aſcribed to the different Inclina-

" tion of the Parts of the painted Paper to the Sur-" face of the Lens." But in my Account of the Experiment in the *Philoſophical Tranſactions*, I mentioned particularly that the Axis of the Lens was perpendicular to the Image of the Card, and therefore there could be no different Obliquity, as is objected. " That though he found the *Spectrum* of Colours " produced by the Priſm in a dark Room to ſhorten by " Degrees, and at laſt become round and colourleſs " (that is *white*) when viewed by another Priſm, in " the ſame manner that Sir *Iſaac Newton* had made " the Experiment; yet it did not convince him of the " different Refrangibility of the Rays; becauſe when " he had cauſed an Image to be painted upon a Paper " like the *Spectrum* from the Priſm, and enlightned it " by the direct Light of the Sun, it did not become " round and white when viewed through a Priſm as " the other *Spectrum* did." But he did not conſider the Imperfection of Painters Colours, nor remember that the Surfaces of Bodies, whether of a natural, or a painted or died Colour (ſuch as he calls *permanent Colours*) when expoſed to any coloured Light, will reflect that Colour which falls upon them, and appear to be of no other, only that they will ſeem moſt vivid in that Colour which they bear in open Day; and therefore that if the Sun's Light conſiſts of Rays differently refrangible and producing different Colours (according to Sir *Iſaac Newton*) the Priſm muſt ſeparate the Light reflected from every one of the painted Colours, and could not bring them together, becauſe they were by no means ſimple Colours. If therefore he had reaſoned right, the firſt Experiment would have proved Sir *Iſaac*'s Doctrine, and the laſt would have confirm'd it. And if in his own Experiment he had looked at the painted *Spectrum* ſucceſſively holding the refracting Angle of the Priſm upwards, and then downwards with the ſame Inclination (or, what is eaſier, turned the *Spectrum* upſide down, the Priſm remaining fix'd) he would have ſeen his *Spectrum* ſhorter in one Caſe than in the other.

" That Sir *Iſaac Newton*'s 8th Experiment of P. I. " B. II. (in which the priſmatick *red* and *blue* falling " ſucceſſively on the ſame Place of a Book, have " a different Focus in projecting their Image through a " Lens) is inconcluſive ; and rejects *Richterus*'s " Anſwer, *viz. That the Colours reflected from the " Book, as it has a rough Surface, fall always with " the ſame Inclination upon the Lens, in what- " ever Direction they came from the Priſm to the " Book* ——— adding, That he had acquainted " *Richterus*, that *permanent* Colours enlighten'd by " direct Light in any different Inclination, always fell " upon the Lens with the ſame Inclination ; but ap- " parent Colours, which were produced by Refraction " with a Priſm, differed from permanent Colours in " their Incidence : But that *Richterus* had purpoſely " concealed it."

N.B. It is not likely he would have concealed it, if it had been true.

" That Monſieur *Marriotte*'s Experiments diſprove " the different Refrangibility of Colours"; though, if he had read with Attention and Impartiality the Account of the Experiments which I made before the *Royal Society* by their Order on that Occaſion (*Phil. Tranſ.* Numb. 348.) he might have been convinced as well as ſeveral Gentlemen of the *French Royal*

Academy,

Academy, who had ſeen Monſieur *Marriotte* make his Experiments, and acknowledged themſelves ſatisfied when they ſaw me repeat thoſe of Sir *Iſaac* in the Year 1715.

" That in the firſt Experiment of Sir *Iſaac* (Book I.
" Part II.) He never could deſtroy any one Colour, the
" reſt remaining; and that with a larger Obſtacle
" he could deſtroy the *yellow* and *blue*, but not the
" *yellow* and *green* — could bring the *green*, not the
" *yellow*, to be next to the Shadow——and could leave
" the *green* only remaining, but not the *yellow*." This is an eaſie Experiment; but Inaccuracy and a very bad Priſm, and Prejudice towards an Hypotheſis, or againſt an Adverſary, may miſlead a Man ſtrangely.

" That when the Colours produced by the Priſm,
" and afterwards united by the Lens, produce *white*
" upon a Paper in the Focus, no Inclination of the
" Paper will tinge the white Spot with Colours".

" That a *yellow* Paper in the *blue* Light appears
" *green*, as does alſo a *blue* Paper in the *yellow*
" Light."——But not when the Room is well darken'd, and the Light homogeneal.

" That Sir *Iſaac Newton* aſſerts falſly, that Light
" immerging into a Parallelipiped, and then emerging
" out of it, produces no Colours."

" That the 6th Experiment of Part I. Book I. of
" Sir *Iſaac* is true; but no different Refrangibility of
" Rays is prov'd by it, though the Colours coming
" ſucceſſively from the firſt Priſm to the ſecond with
" the ſame Incidence, are carried to different Heights
" by the laſt Priſm." Now the Conſequence is ſo plain here, that this is, after my Lord *Bacon's* Manner, called an *Experimentum Crucis*.

I ſhould go on with my Account of this Book, if it could be of any Uſe either to vindicate Sir *Iſaac Newton*, or to convince the Author and his Adherents, if he has any. But Sir *Iſaac*'s Opticks need neither Defence nor Explanation. And when the Author is in the Humour to be convinced, *ten Months* well employed in reading Sir *Iſaac*'s Book, will make him amends for his *ten Years* prejudiced Examination.

I beg Leave now to give the particular Deſcription of a few Experiments I made upon this Occaſion, ſome of which are exactly as Sir *Iſaac Newton* made them: Some are his, but made ſomething differently, and ſome altogether my own.

EXPERIMENT I. FIG. I.

I prepared a Box of about three Foot high, and one Foot wide within (whoſe Shape was a truncated Pyramid) in the following Manner. I painted the Inſide of it black, and in the back Part, one Foot above the Baſe, made a ſquare Hole of three Inches in Width (whoſe Section is *r r*) to receive a Piece *R* ſhutting cloſe with a Rabbet or Shoulder, whoſe Surface coming through the Hole was wholly covered with the painted Paper, on which the Experiment was to be made. Over againſt *r r*, in the fore Part of the Box, was a Door to open with a Tube in it, four Inches wide and five Inches long, whoſe Section is *e*, *f*, *g*, *h*, that two Candles ſet on the Places *i*, *k*, to enlighten the Paper at *r*,*r*, might throw no direct Light out of the Box, whoſe Section is repreſented at *a b c d*. Then having made the Room perfectly dark, I fixed the Box upon a Table, that it might remain in one Place; at the Diſtance of eight Foot from *r r*, I fixed the Lens L L, of four Foot Focus, in a Frame upon another Table, with its Axis going through the Middle of *r r*: At the Diſtance of about eight Foot beyond the Lens, I ſet up the Skreen or Square of white Paper S. Having put into the Hole *r r* a ſtiff Paper, painted with Vermillion, and wrapped four Times and an half with black Silk (as repreſented by R), that Paper enlighten'd by the Candles at *i*, *k*, the Image of the red Paper was projected upon the Skreen at ρ, and when the moſt diſtinct Place was found, the Skreen was fixed: Then a Paper painted with Ultramarine being fixed in the Hole *r r*, the Image of it was ſo indiſtinct at ρ, that the Images of the black Silks could not be ſeen; but holding a Piece of Paper cloſe to the Skreen, and bringing it forward, at about ¾ of an Inch from the Skreen, the Repreſentation of the Silks began to appear on the blue Image; but it was moſt diſtinct at an Inch and ¾, or at Z Z; ſo that there was 1¾ Inch between the diſtinct Baſe of the *red*, and that of the blue Paper. But what has led ſeveral People into an Error in making this nice Experiment, is the Depth of the Focus of the Rays in both Caſes; for though the red Image was moſt diſtinct at ρ, yet the Repreſentation of the black Silks might juſt be perceived by a good Eye when the Skreen was moved backwards or forwards ¾ of an Inch: The blue Image which was ſtronger had its Silks viſible an Inch on either Side of Z Z; ſo that in a Paper half red and half blue, painted with theſe Colours, one might have ſeen the Silks (though faintly) upon the two Images at once, and have been thereby deceived: But ¾ of an Inch beyond the Place common to both, the *red* alone would have appeared diſtinct; and an

Inch ſhort of the ſaid Place, the blue Image moſt diſtinct, and diſtinct alone; that is an Inch and ¾ nearer the Glaſs. Inſtead of *Vermilion* the red Paper may be painted with *Carmine* or *Lake*, but it will not do ſo well, as was then tried; nor does *Pruſſian Blue* do ſo well as *Ultramarine*. The beſt Way is to heighten the *Vermillion* with a little *Carmine*, and the *Ultramarine* (which has too much *white*) with *Indigo*; and then there will be a Space between the two diſtinct Baſes where both the Images will be indiſtinct. N. B. *I made the Experiment with ſuch Colours, in the Year* 1722; *but now I uſed no Mixtures, that any Body elſe might repeat the Experiment.*

The ſecond Figure repreſents the Box with one Side out, whoſe Place is *δ d b B*; *e g* is the Hole for the Tube in the Door of the Foreſide, *κ δ c d*; *r r* the Hole in the Back to receive the Piece R with its painted Paper.

The third Figure is the Box open before, with the Candles and Paper in it, the ſame Parts being marked with the ſame Letters as in the other Figures.

N. B. I made the Experiment in this Manner, becauſe Signior *Rizzetti* attributed the different *Foci* of the Colours to different Inclinations, which could not be alledged here; the *red* and *blue* being, as he had deſired, ſucceſſively fixed in the very ſame Place: And he ſays (Page 64.) *addidi permanentes colores a lumine directo diverſa inclinatione illuſtratos conſtante Inclinatione in lentem incidere.* Nay, more than this was performed in the Experiment; for as the Candles were fixed, the Light fell upon the painted Paper always with the ſame Incidence.

EXPE-

EXPERIMENT II.

Inſtead of the red or blue Paper at r r (*Fig*. 1, 2, and 3,) I fixed upon the Piece R, a Paper half *red*, and half *blue*, as R B (*Fig*. 4.) then over the Hole in the fore Part of the Box repreſented by *e g* (*Fig*. 2.) I fixed a ſquare Plate *κ δ c d* (Fig. 4.) with an oblong Hole in it four Inches long in its Horizontal Poſition, and one Inch deep, through which one might ſee the parti-coloured Paper, as if it was only of the Bigneſs and Figure of this Aperture, and ſtrongly enlighten'd by the Candles hid in the Box; the reſt of the Room being very dark. N. B. *I made this Preparation, becauſe* Rizzetti *objects to Sir* Iſaac Newton's *firſt Experiment of the firſt Book, that the black Cloth beyond the parti-coloured Paper, was not colourleſs, and therefore the Experiment was not deciſive as particularly relating to the Paper.*

R B (*Fig*. 5.) is the Paper contracted in Length and Breadth by the Aperture of the Plate, which Paper being looked at, at the Diſtance of five Foot, by the Priſm 1, appeared as drawn at r b. The Priſm being removed to 2, at the Diſtance of ten Foot, ſhewed the Paper as at *r b*. And when it was at 3 (at the Diſtance of fifteen Foot) the Paper appeared as *ρ β*. In theſe three Caſes the blue b, *b*, and *β* appeared lower than the red r, *r*, *ρ*, the refracting Angle of the Priſm being downwards. When the refracting Angle was held upwards, as at 5, then the *Blue* B was raiſed higher than the *red* R; but if due Care be not taken, in turning the Priſm, a Reflection may be miſtaken for a Refraction, as at 4; and then indeed the *Red*

and

and *Blue* will be equally raiſed as at T. This muſt have been Signior *Rizzetti*'s Miſtake, when (in *Page* 38.) he ſays that one Colour was raiſed higher than the other by two Lines, at ten Foot Diſtance, but not at all at five Foot; for ſeveral of the Perſons preſent at my Experiments, made the ſame Miſtake at firſt before they could perform the Experiment in manner abovementioned; which they at laſt did, and found the Colours ſeparated moſt at the greateſt, and leaſt at the leaſt Diſtance. This miſtaking a Reflection for a Refraction, has been the Occaſion of ſeveral more Errors, and Difficulties to be met with in Signior *Rizzetti*'s Book.

EXPERIMENT III. FIG. VI.

A Candle K, reflected from the Surface A B of the Priſm A B C, appeared very faintly to the Eye at E, as a weak Image at k; becauſe the Rays incident at I, paſs moſt of them through the Priſm, and go on to R, ſeparating from one another according to their different Degrees of Refrangibility; whilſt a few of them are reflected to the Eye in the Direction I E.

But if the Priſm be in the Poſition ACB (*Fig.* 7.) moſt of the Rays of the Candle K, incident at I, on the Plane A B (after having paſſed perpendicularly through the Plane BC) are reflected, and paſſing perpendicularly through AC, go into the Eye at E, which ſees a very ſtrong Image of the Candle at k, whilſt very few Rays go down to R to produce Colours.

This ſhews that the Rays of Light paſs with more Facility through Glaſs (a denſe) than through the Air (a rare) Medium; contrary to *Rizzetti*'s Aſſertion.

EXPERIMENT IV. FIG. VIII.

To make this more evident, and compare together the Facilities with which Light paſſes through the two Mediums, I took a Cube of Glaſs of three Inches the Side, A *a b* B *d* D C, whoſe Section is A B C D, and looking upon it from E to ſee by Reflection the Candle K, I ſaw two Images of it; one at *k* very faint, and reflected from the upper Surface A B, and the other at κ very ſtrong, and reflected from the lower Surface C D. Now it is evident, that the Vividneſs (or Brightneſs) of the Image κ, is to the Vividneſs of the Image *k*; as the Facility with which the Rays, in theſe Circumſtances paſs through the Glaſs, or through the Air: and thoſe are eaſily compared, becauſe both the Images are ſeen at once.

EXPERIMENT V. FIG. IX.

The Line P I being perpendicular to the reflecting Plane A B of the Triangle A C B, I brought the Candle K by Degrees ſo near to P, as to diminiſh very much the Angle of Incidence K I P, which made the Image or Appearance of the Candle at *k*, become fainter by Degrees, and at laſt as faint as in *Fig.* 6.

EXPERIMENT VI. FIG. X.

Having made the Experiment as at *Fig.* 7, I preſſed another Priſm D F G, cloſe to the Priſm A B C, and when I ſqueezed them together but gently, ſome of the Rays from the Candle R, paſſed through the lower Priſm, and falling upon a Paper at R, made a reddiſh Spot ; but when I ſqueezed them very hard, the Spot became much wider, white in the Middle, and only tinged with Red about the Edges: At the ſame Time the Eye ſaw a black Spot in the Image of the Candle at *k*; and a Stander-by looking obliquely at the Place I (where the Glaſſes touched) ſaw, as it were, a little Hole through the Priſms as big as the Spot *k*. But if the Priſms be preſſed together but gently, then all the other Phænomena diſappear, except the firſt little Spot at R, as in Fig. 11.

When the Candle is ſeen by Reflection from the lower Surface of a Priſm, as in the 7th, 9th and 10th Figures, the Rays paſs quite through that Surface, and are turned up again by the Attraction of it in Curve Lines ſo as to re-enter the Priſm, and then (going out again through the Surface A C) go up to the Eye at E. In this Caſe the moſt refrangible Rays, being the moſt eaſily inflected, make the leaſt Curves, whoſe Vertices are nearer the Glaſs than thoſe of the greater Curves made by the leaſt refrangible Rays. This is proved by Experiment 6, where the under Priſm only attracts down from the Reflection of the upper Priſm, the Red making Rays as in *Fig.* 11. where the Plate of Air between the Priſms is of ſome ſmall Thickneſs. But when the Priſms, whoſe Surfaces are a little convex, are preſſed hard together, the lower Priſm is near enough to attract Rays of a great Degree of Refrangibility; and therefore the Spot then becomes white in the Middle; and only red about the Edges, which are produced by ſuch Parts of the lower Priſm as are not ſo near the upper Priſm.

There are two Circumſtances in the 6th Experiment, which diſprove *Rizzetti*'s Aſſertion (Page 125) *viz.* That there is a ſenſible Reflection even where Glaſſes touch; for when the Priſms touch at I *Fig.* 10, the black Spot appearing in the Image of the Candle *k* ſhews that there is at I a Deficiency of thoſe Rays, which, coming from the Middle of the Candle, uſed to be reflected up to the Eye at E, and therefore that A B the reflecting Surface of the upper Priſm ceaſes to reflect in a little Space round about I where the upper Surface D F of the under Priſm touches it; the Rays, which before were reflected, now going down to make the Spot at R. The other Circumſtance is this; that whereas a Paper at *k* is inviſible to an Eye at E by the Interpoſition of the Priſm D F G; when another Priſm A C B is laid over it and preſſed hard, there appears to be an Hole of about $\frac{1}{8}$ of an Inch (more or leſs in Diameter as the priſmatical Surfaces are more or leſs flat) thro' which the Paper at *k* becomes viſible; this being the Place of Contact where the Reflection downwards (of the Surface D F) ceaſes.

This happens becauſe thoſe Rays, which (coming from the Candle K) were bent in Curves under the Surface A B of the upper Priſm about ſeveral Points near I, are by the Nearneſs of the Surface D F of the lower Priſm brought down to R, inſtead of being turned up again to the Eye at E; whilſt thoſe Rays, which (coming from the Paper at *k* thro' the Surface G F of the lower Priſm, and paſſing thro' the upper Surface of it F D) were bent in Curves about ſeveral Points near I, are prevented from turning down again to R, and are brought up to the Eye at E, which conſequently muſt ſee a round Part of the Paper at *k*, juſt as big as the Place of Contact, which appears like an Hole ; or as if the two Priſms being changed to a Parallelopiped, were covered with a dark Paper that had only a ſmall Hole in it.

But to make this more evident, eſpecially to ſuch as are not well acquainted with Sir *Iſaac Newton*'s Opticks, I beg Leave to explain the Manner of the bending of the Rays where they are refracted or reflected.

Of the Bending of the Rays in their Refraction.

Let DD (Fig 12) repreſent a denſe Medium (as Glaſs) whoſe Surface is GG, and A A a rare Medium (as Air). Now let us ſuppoſe a Power to extend all over the Surface G G, acting from A A towards D D in Lines perpendicular to the Surface G G, very ſtrong in Contact, but inſenſible at a very ſmall Diſtance from the ſaid Surface, which we will call the *Attraction of the Surface* G G, without conſidering whether it be any real Virtue in the ſaid Surface, or the Action of a Medium impelling towards it. Let Lines 11, 22, 33, ſuch as expreſs the Lines in which the Attraction exerts it ſelf, and the Line M M (extremely near to G G) the Limits of the Attraction, beyond which it cannot affect a Ray of Light. Let the Ray of Light R *a* moving from a rare Medium into a Denſe in the Direction R r, come towards the Surface G G in ſuch an Angle that it may be refracted. When the Ray comes to *a*, by the Attraction at *a* it will be acted upon in the Line *a* b, and (by the known Laws of Mechanicks) be turned out of the Way into the Direction *a* a, inſtead of *a* r: When it is got to *b*, being acted upon in the Direction *b* 4, its new Direction will become *b* b: At *c*, by the Power acting in the Line *c* 5, it will change its Direction to *c* c; and laſtly, at *d* it will go into the Glaſs in the Line *d* d, continuing in that ſtreight Line whilſt it moves in that Medium.

Now if the Lines 11, 22, 33, *n*, *c*, *b*, *a*, be infinitely near (as they muſt be ſuppoſed to be) the Ray, inſtead of being broken into the ſeveral ſtreight Lines *a b*, *b c*, and *c d*, will be bent into the Curve *a b c d*; and the emergent Ray *d* d will make the ſame Angle with the Incident Ray R r as if the Refraction had been made at once at the Point *n*, which Point may be conſidered as in the Surface G G, becauſe M M has been ſuppoſed extremely near that Surface: Then alſo may Refractions be conſidered in groſs, and Rays trac'd, in all Optical Propoſitions, as if there were no ſuch Curve as what we have been deſcribing.

Again, let D (*Fig.* 13) repreſent the denſe Medium or Glaſs, and A the rare Medium or Air; R *a* a Ray of Light coming out of the denſe Medium into the Rare, in the Direction R *r*, in which it may be refracted (as for Example, in an Angle of 30 Degrees with the Perpendicular P *a*). Let M M be the Line which limits the Attraction of the Surface G G, which Attraction is exerted in Lines tending perpendicularly from M M to G G. As ſoon as the Ray of Light has emerged at *a*, it is attracted in the Direction *a* P, and therefore diverted from the Line *a* r, into the new Direction *a* a; at *b*, it is turned into the Line *b* b; at *c*, into the Line *c* c; and at *d*, in-

d, into the Line *d* d; ſo that the emergent Ray will be *d* d, as if the Refraction had been performed in the Point *n*, and that Point was in the Surface G G, without any Curve at *a b c d*; and all the reſt as we conſidered it before, with this Difference only, *viz.* That the Ray is bent juſt as it comes out (or rather when it is come out) of the denſe Medium; whereas before we conſidered its Bending before it came into it.

Of the Bending of Rays in Reflection.

But if the Ray R *a* (*Fig.* 14) coming out of Glaſs into Air, ſhould come in ſuch a Direction as to be wholly reflected, as it will do when the Angle R *a* P is of 45 Degrees; I ſay the Reflection will not be made at the Surface G G, nor above it in the Glaſs; but under the ſaid Surface, in the Air, or even in a Vacuum, or any Medium leſs denſe, or rather leſs refractive than Glaſs.

M M repreſents the Limits of the Attraction of the Glaſs exerted in a Direction from M M to G G perpendicularly, as we ſaid before.

The Ray R *a*, moving in the Direction R r, at its Emerſion at *a*, is, for the Reaſons before given, turned into the Direction *a* a; then at *b*, into the Direction *b* b; at *c*, into the Direction *c* c; at *d*, into the Direction *d* d; at *e*, into the Direction *e* e; and at *f*, into the Direction *f* f parallel to G G; then at *g*, the Ray is again turned towards the Glaſs, by whoſe Attraction changing ſucceſſively into all the Directions *g* g, *i* i, *k* k, and *l* l; at laſt it re-enters the Glaſs in the Direction *m* m making the ſame Angle with the Perpendicular *m* p that R *a* made with *a* P. Now as the Lines perpendicular to G G drawn from M M are infinitely near, the Line *a b c d e f g h i k l m* muſt be a Curve; and as M M and G G are extremely near, the Vertex of the Curve (whoſe Tangent is *f* f parallel to G G) will be ſo near the Point I, as to be conſidered as co-inciding with it, when we compare the Angle of Incidence with that of Reflection; then alſo will the Space between the Parallels p *m* and P *a* be ſo far diminiſhed, that thoſe two Lines may be looked upon as co-inciding, the Angles m *m* p and R *a* P being equal, whether the three Points *m*, I, *a*, co-incide or not.

For theſe Reaſons, for common Uſe, one may conſider the Reflection from the under Surface of the Glaſs as made at once in that Surface at the Point I. But when we examine Things ſtrictly, Experiments as well as the above Reaſoning, will ſhew, that there is ſuch a Curve as we have mentioned. *See* Experiment VI. *Fig.* 10 and 11; and we ſhall mention others.

N. B. If any Point of the Curve *a b c*, &c. between *a* and *f*, fall below (or beyond the Line M M, the Ray will then go on in a ſtraight Line Tangent to the Curve in that Point where it leaves the Line M M.

Now let us ſuppoſe M e d c b a r M (in the ſame *Fig.*) to be Glaſs, or any other denſe Medium, and m p P R Air, or any other rare Medium, and R *a* a Ray of Light moving in the rare Medium towards the denſe Medium in the Direction R *a* towards r; if inſtead of an Attraction at the Surface of the Glaſs

M M, there be ſuppoſed a repellent Force, whoſe Limits are G G ; then will the Ray by the Repulſion of the Surface M M be bent into the Curve *a b c d e f g h i k l m* in the ſame Manner as we ſhewed it would be under the Surface G G, when G p P G was conſidered as a denſe Medium. Hence it follows that a Ray moving in the Air, is reflected from a ſpecular Surface of Glaſs, or any other Mirrour, opake or diaphanous, without touching the ſaid Surface.

N. B. *That the ſame Power may, under different Circumſtances, attract to and repel from the ſame Surface, ſhall be made out in the remaining Part of this Paper; but now taking ſuch a Power for granted, we will proceed in conſidering the Flexure of Rays of Light.*

Let us ſuppoſe a Priſm A C B (*Fig.* 15) to have the attracting Power of its inferior Surface extend as far as the Line *m m* ; if another Priſm G D F (the attracting Force of whoſe upper Surface extends as far as *n n*) be brought very near to the firſt Priſm ; where the attracting Powers of the Priſms interfere, they will deſtroy one another, becauſe they act in contrary Directions; and thereby the Limits of Attraction of each of the Surfaces will be contracted ; the Power of A B extending no farther than *n n*, and that of D F no farther than *m m*, whilſt the Space *n n m m* loſes all the Force that it had (and would have upon the Removal of either Priſm) to turn a Ray of Light, moving obliquely, out of its Direction.

Now in this Situation of the Priſms, a Ray of Light entering the Surface C B at right Angles, will go through the ſecond Priſm alſo at Right Angles (not exactly in the ſame Line, but) in a Line parallel to the Direction of the incident Ray: For Example, let the Ray *R a* (not refracted at, becauſe perpendicular to, the Surface C B) emerge from the firſt Priſm at *a*, in the Direction *a r*; its changed Direction at *a* will become *a* a, and at *b*, *b* b, or rather the Ray will be inflexed in the Curve *a b*; and at *b* getting out of the Power of the Attraction of the Surface A B, it will (for the Reaſons before given) move in a ſtraight Line from *b* to *c*, where it will be bent again the contrary Way in the Curve *c d* of the ſame kind as *a b*, and laſtly emerge in the Direction *d* d parallel to the firſt Direction R r. From hence it follows, that when the Priſms are brought ſo near as to touch, their mutual Attractions deſtroying each other, the Rays of Light will not be bent, but paſs through the two Priſms (which in this Caſe perform the Office of a Parallelopiped) in the ſame Direction with which they came into the firſt Priſm, and conſequently produce no Colours; contrary to what is affirmed by *Rizzetti* (*Page* 78, 79, &c.) and when the Rays R *a* fall obliquely upon the Surface C B, the Effect of their Refraction at their Immerſion at S to produce Colours, is taken off by the Refraction which they ſuffer at their Emerſion at z.

EXPERIMENT VII.

I took the Cube of *Fig.* 8, and looking obliquely through it at the Hole of the Window of my dark Chamber (the Sun ſhining or not ſhining) the Hole appeared entirely colourleſs, as did alſo a Candle,

both

both appearing fringed with Colours when ſeen through the Priſm. Then holding two Priſms together, as in *Fig.* 10, if the Hole of the dark Chamber be at k, it appears white to the Eye at E; but if the Angles of the Priſms at B F be a little ſeparated, whilſt the Points A D touch, the Hole will appear coloured: When the Surfaces are ſeparated at A D, and touch at B F, the Colours appear in an inverted Order; but if the Surfaces A D and B F are parallel, whether they touch or not, the Hole will appear white.

N. B. *In this Caſe the Priſms muſt be ſimilar, that the Surface* F G *may be parallel to* A C; *otherwiſe* A B *and* D F *muſt be ſo inclined to one another as to render* A C *and* F G *parallel. Indeed if one of the Priſms be very far removed from the other, the heterogeneous Light which entered in at* F G, *may be ſo far ſpread by the Separation of the differently refrangible Rays, that the Priſm* A B C *will not take it all in; then the Eye behind the ſecond Priſm may ſee Colours, as I ſuppoſe* Rizzeti *did.* See *Page* 79 of his Book.

If the Ray of Light R *a b c d* d (*Fig.* 15.) changing its Direction in the Manner above-mentioned, makes an Angle of about 45 Degres with the Perpendicular P *a*; upon the removal of the lower Priſm, the Ray will be turned up again, as in *Fig.* 14. But if the Angle P *a* R be greater, the Ray will ſtill be turned up again in a Curve, as *a b c d e f*, (*Fig.* 16) notwithſtanding the lower Priſm is at D F G; but if that Priſm be brought up cloſer to the Surface A B, the Curves will be deſtroyed where the Priſms touch, and all the Rays in the Place of Contact brought down through the lower Priſm.

THE moſt refrangible Rays conſiſt of ſmaller Particles than the leaſt refrangible Rays, and therefore muſt have leaſt *Momentum*, the Velocity of all the Rays being the ſame; and conſequently are more eaſily turned out of the Way by Attraction or Repulſion, which makes the Curves made by the purple and violet Rays under the Surface A B, to be leſs and nearer the ſaid Surface than the Curves made by red and orange Rays.

Suppoſe a Violet R *a* moving in the Direction R r (*Fig.* 16.) to be ſo bent under the Surface A B, that at the Vertex of the Curve, or where its Tangent *c* c is parallel to A B, there ſtill remains a ſmall Space between the Curve and the Line *n n*, where the Limits of Attraction (contracted by the Proximity of the undermoſt Priſm D F G end) that Ray will be turned up again in the Curve *d e f*, and ſo reflected in the Line *f* f, the Directions having been ſucceſſively changed, as in *Fig.* 14. But a red Ray with the ſame Inclination, would paſs on into the lower Priſm, as was explained in *Fig.* 15. Becauſe the Momentum of the red Ray being greater than that of the Violet, the ſame Degree of Attraction could not give it the ſame Flexure.

This is confirmed by Experiment, for when the lower Priſm is not preſſed hard againſt the upper (as in *Fig.* 11.) the Rays brought down to R make a Spot of a Colour made up chiefly of red and orange Rays; but when the Priſms are preſſed cloſer, the Spot grows bigger and perfectly white in its Middle, becauſe all Sorts of Rays are brought down to the Spot; but it is incloſed round with a reddiſh Border, occaſioned by the Parts of the Priſm which are very near, but not in Contact, or at leaſt not near enough to bring down the green, blue, purple and violet Rays. This ſhews that the Reflection is not made from the interior ſolid Parts of the Glaſs, nor from the Parts in the Surface, as *Rizzetti* affirms. But this is made more evident by

EXPERIMENT VIII. *Fig.* 17.

A Candle being in the Poſition K, the Eye at E, and the Priſm at ABC; a ſtrong Image of the Candle was ſeen at k as in *Fig.* 7. But lifting up a Veſſel of Water VSSV till the Surface of the Water VV touched AB the lower Surface of the Priſm, the Image of the Candle became almoſt inſenſible, as the Eye loſt all thoſe Rays which now were attracted into the Water. And for a farther Proof, that the Reflection is made under the Surface and not in it, when the Priſm was taken out of the Water, being wet at its lower Surface, or having a *Stratum* of Water (whoſe Surface was VV *Fig.* 18) under AB, the Image of the Candle did again become vivid, the Rays being turned up again under VV. Indeed the Image, in this Caſe, though ſtrong, did not appear well defined, by Reaſon of the Unevenneſs of the watry Surface VV *Fig.* 18.

I am very well aware that *Rizzetti* may anſwer here, that what I have ſaid above, does in ſome Meaſure favour his Notions; and that the Rays which (in *Fig.* 7, having paſſed through AB, the lower Surface of the Priſm) are turned up again to the Eye at E, do not ſuffer a Reflection but a new Immerſion; for he ſays, in *Page* 125. —— " Anglus (meaning Sir

“ *Iſaac Newton*) ſecundo ſubjungit, *quod ſi lumen in tranſitu è vitro in aerem obliquiùs incidat, quam in angulo graduum* 40, *illud in totum reflectitur.* Ego verò reſpondeo, quod ex iis, quæ docui in Prop. 4. Cap. 1. elicitur hanc non eſſe veram luminis reflectionem, ſed potius novam Immerſionem; & ideo nego quod ex iſto Phænomeno ſequatur lumen a partibus corporum ſolidis, aliquo interjecto intervallo, reflecti.” And a little lower, having quoted what Sir *Iſaac Newton* ſays, concerning the blue Light, which, coming from one Priſm obliquely upon the farther Surface of another, is wholly reflected, at the ſame Inclination that the red Light is wholly tranſmitted. — He ſays, “ Satis ſit iterum reſpondere, quod in hoc etiam caſu eſt nova luminis immerſio, quæ dicitur ab auctore reflectio.

But this is only cavilling about Words; for if the Ray of Light, which moving in a denſe Medium falls obliquely on the Surface common to that and a rarer Medium, be turned back again in the denſe Medium, ſo as to make the Angle in which it returns from the ſaid Surface equal to that in which it came to it; this Return of the Ray may properly be called a *Reflection*, whether the Ray be turned back at the Point of the Incidence in the Surface, or be carried about the Point of Incidence in a ſmall Curve, whoſe Conſideration may be omitted in tracing the Way of a Ray of Light in its Paſſage, for making of optical Machines. Whoever reads the 8th Prop. of the 2d Part, Book II. of Sir *Iſaac*'s Opticks, may very eaſily find that he was not ignorant of the turning back of the Ray under the Surface of the Glaſs before it returned into it: And though the Reflection in that Caſe be not made by impinging on the ſolid Parts of the Glaſs, yet it is owing to them that the Light (acted upon at a Diſtance) is turned up again, as has been ſhewn by ſeveral of the Experiments abovementioned.

Now let us ſee how *Rizzetti*'s Account of the new Immerſion agrees with *Phænomena.*

Let all above the Line P p (*Fig.* 19) be a denſe Medium, as Glaſs; and all below it a rare Medium, as Air; A B C D is a Beam of Light inſenſible in Thickneſs, but of ſome Breadth, whoſe Rays cohere to one another, and whoſe Section or firſt Line is B C. If the Medium in which B C is, did not change, B C would move parallel to it ſelf in the Lines B *a* and C *d*; but as the End C of the Line B C comes out into a rare Medium, which being of leſs Reſiſtance to Light (for ſo he ſuppoſes) the Point C moving with more Facility than the Point B deſcribes the Curve C F H, whilſt B moving in the denſe Medium with more Difficulty, deſcribes the leſſer Curve B E G; then the Point C being got to H is re-immerſed, and the Line B C being got to H G goes on in the Direction H K G L parallel to itſelf, drawing the Beam after it in a rectilinear Direction, after Part of it has been bent within the Glaſs and Part of it without.

Now if this be true, and P p π be a Priſm, I beg to know what becomes of the Line at E F which unites the Rays of the Beam about the Point of Incidence I, when Water is brought to touch the Surface P p, as at A B *Fig.* 17? If it be ſaid that Water making a great Reſiſtance, though not ſo great as Glaſs, the Curve B E G deviates ſo little from the Line B *a* that the Point E comes below I, and the Beam is wholly refracted; I aſk whence comes the faint Image at k? If it be anſwered, that ſome Part E I of the Line E F (*Fig.* 19) is turned up to the Eye at E (*Fig.* 17;) what becomes of the lateral Coheſion of Light on which *Rizzetti* founds his chief Propoſition, and from which he draws his Conſequences?

It would be tedious as well as uſeleſs to be particular in ſhewing all *Rizzetti*'s Miſtakes; therefore I ſhall only mention one more Experiment from Sir *Iſaac Newton*, which I repeated on Account of what is ſaid in *Rizzetti*'s Preface, *Page* 16, *viz. that if* (*according to Sir* Iſaac) *Rays were differently reflexible, Colours muſt be produced by Reflection from a plane Surface*; *but this*, ſays our Author, *is contrary to Experience*. Now this his Aſſertion is diſproved by

EXPERIMENT IX.

As this Experiment was made exactly in Sir *Iſaac Newton*'s Manner, and with the ſame Succeſs, I repeat the Account of it in his own Words.

" Let H F G [in Figure 20] repreſent a Priſm in
" the open Air, and S the Eye of the Spectator, view-
" ing the Clouds by their Light coming into the Priſm
" at the plane Side F I G K, and reflected in it by its
" Baſe H E I G, and thence going out through its plane
" Side H E F K to the Eye: And when the Priſm and
" Eye are conveniently placed, ſo that the Angles of
" Incidence and Reflection at the Baſe may be of about
" 40 Degrees, the Spectator will ſee a Bow M N, of a
" blue Colour, running from one End of the Baſe to
" the other, with the concave Side towards him, and

“ the Part of the Baſe I M N G beyond this Bow will
“ be brighter than the other Part E M N H on the o-
“ ther Side of it. Now for underſtanding the Reaſon
“ of it, ſuppoſe the Plane A B C to cut the plane Sides
“ and the Baſe of the Priſm perpendicularly. From
“ the Eye to the Line B C wherein that Plane cuts the
“ Baſe, draw the Lines S *p* and S *t* in the Angles S *p* C
“ 50 Degrees $\frac{1}{28}$ and S *t* C 49 Degrees $\frac{1}{3}$, and the
“ Point *p* will be the Limit beyond which none of
“ the moſt refrangible Rays can paſs through the
“ Baſe of the Priſm, and be refracted, whoſe Inci-
“ dence is ſuch that they may be reflected to the
“ Eye; and the Point *t* will be the like Limit for
“ the leaſt refrangible Rays, that is, beyond which
“ none of them can paſs through the Baſe, whoſe In-
“ cidence is ſuch, that by Reflection they may come
“ to the Eye. And the Point *r* taken in the middle
“ Way between *p* and *t*, will be the like Limit for
“ the meanly refrangible Rays. And therefore all
“ the leaſt refrangible Rays which fall upon the Baſe
“ beyond *t*, that is, between *t* and B, and can come
“ from thence to the Eye will be reflected thither:
“ But on this Side *t*, that is, between *t* and C, many
“ of theſe Rays will be tranſmitted through the Baſe:
“ And all the moſt refrangible Rays which fall upon
“ the Baſe beyond *p*, that is, between *p* and B and can
“ by Reflection come from thence to the Eye, will be
“ reflected thither, but every where between *p* and *c*,
“ many of theſe Rays will get thro’ the Baſe and be
“ refracted; and the ſame is to be underſtood of the
“ meanly refrangible Rays on either Side of the Point
“ *r*. Whence it follows, that the Baſe of the Priſm
“ muſt every where between *t* and B by a total Re-

flection

“ flection of all Sorts of Rays to the Eye, look
“ white and bright. And every where between *p*
“ and C, by reaſon of the Tranſmiſſion of many
“ Ray's of either Sort, look more pale, obſcure and
“ dark. But at *r*, and in other Places between *p*
“ and *t*, where all the more refrangible Rays are reflected
“ to the Eye, and many of the leſs refrangible
“ are tranſmitted, the Exceſs of the moſt reſtangible
“ in the reflected Light will tinge that Light
“ with their Colour, which is violet and blue, this
“ happens by taking the Line C*prt*B any where
“ between the Ends of the Priſm H G and E I.

If this needs any farther Explanation, let us ſuppoſe C A B the Section of the Priſm in *Fig.* 20. transferred to *Fig.* 21. at A C B. If R *o* be a red Ray inclined to a Perpendicular to A B in an Angle of more than 41 or 42 Degrees, it will at its Emerſion under the Surface A B be turned into the Curve *o n m i*, and ſo go up again to the Eye at E; but another red Ray coming in the Direction *r n* making an Angle with the Perpendicular ſufficiently leſs, will after its Emerſion at *n*, be only bent ſo much as to be turned out of the Way, and refracted to *q*, in an Angle of Refraction agreeable to the Refrangibility of red Light. But V *m* a violet Ray with the ſame Inclination as the laſt red one *r n* ſhall not be refracted, but turned up in the Curve *m i* P, and ſo go to the Eye at E. Another violet Ray v *m* making an Angle ſomething leſs with the Perpendicular, will paſs through the Glaſs, and be refracted in the Line *m* S. Upon this Account all that Part of the Baſe of the Priſm (of which A B is the Section) between A and *p* will be dark or faint, all that Part between *p* and *n* be tinged with a bluiſh Colour, and all between *o* and B of a bright White.

POSTSCRIPT.

THE Bending of Rays of Light juſt as they come to be reflected or refracted, may be eaſily underſtood by ſuch as are well acquainted with thoſe Properties of Light, which Sir *Iſaac Newton* calls their *Fits of eaſy Reflection*, and *Fits of eaſy Tranſmiſſion*; without any Hypotheſis, but by Conſequences fairly drawn from Experiments and Obſervations. But as Signior *Rizzetti* does not ſeem (in his Book) to have the leaſt Notion of thoſe Properties of Light, and the nice Obſervations on which they are founded; and ſeveral other Perſons have not Time to read thoſe Parts of the Opticks with ſufficient Application; to ſhew how the ſame Power of the Surface of a denſe Medium may both attract and repel under different Circumſtances —— I content myſelf here with giving the Hypotheſis, which Sir *Iſaac* does before he comes to that Part of his Book where he demonſtrates the Fits abovementioned.

If GG be the Surface of a denſe Medium GDDG, on which a Tremor is cauſed by the Warmth communicated to it by the Rays of Light, ſo as to give a Wave-like Motion to the Medium immediately next to the Surface GG; as that vibratory Motion is performed, the Medium alternately puſhes from the Surface, and returns towards it (as is repreſented by the Poſition of the Darts in the Darts in Figure) and puſhes back the Light ſo as to reflect it when the Vibration is contrary to its Direction, but brings it down to be refracted when the Vibration conſpires with the ſaid Motion. *See a further Account of this in Sir* Iſaac Newton*'s Opticks*, Book II. Part 3. Propoſition 12.

The Perſons preſent at the Experiments abovementioned, tried them as well as myſelf, and being ſatisfied with the Succeſs of them, allowed me to mention it, and make uſe of their Names in this Account.

Of the ROYAL SOCIETY.

Sir *Hans Sloane*, Preſident.
Dr. *Scheutzer.*
Mr. *Grey.*
Mr. *Georges.*
Mr. *Dugood.*

Other GENTLEMEN.

Colonel *Spotſwood.*
Mr. *Haily.*
Mr. *Graham.*
Mr. *Hewet.*

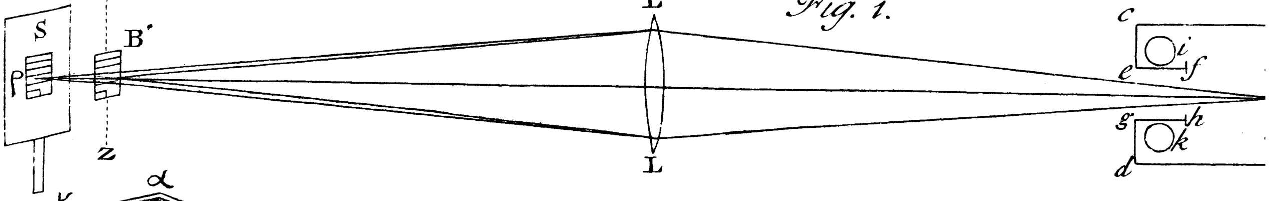
FOREIGNERS.

The Abbot *Lercari*, a Nobleman of *Genoa*, Couſin to Cardinal *Lercari.*

The Abbot *Cuzzoni.*

The Abbot *Rolli*, and his Brother.

Fig. 1.



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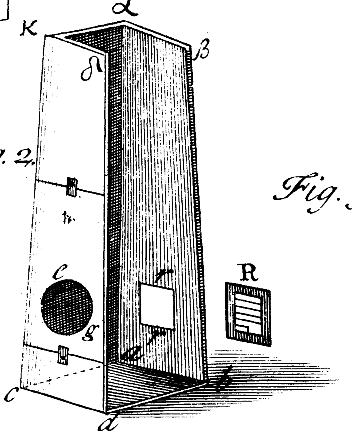

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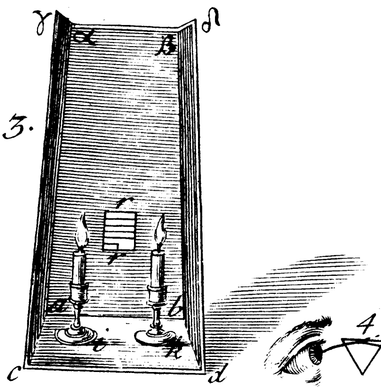

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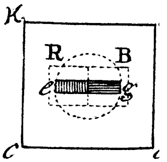

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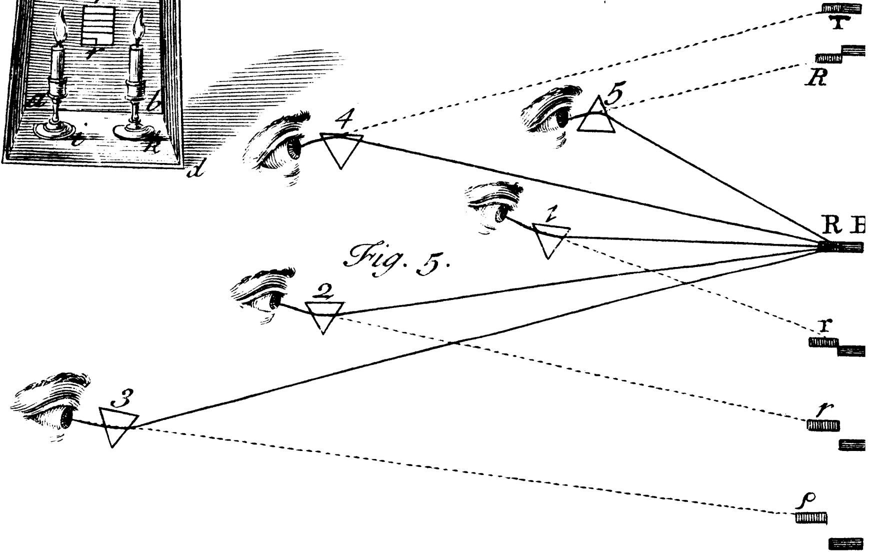

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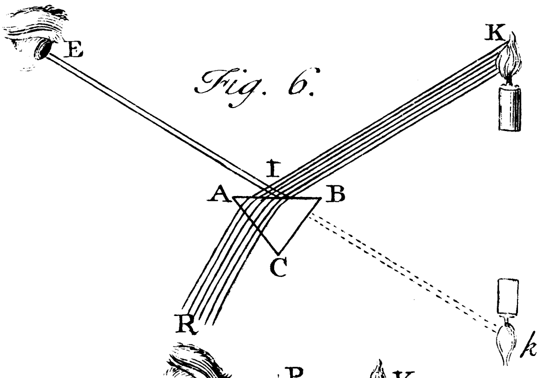

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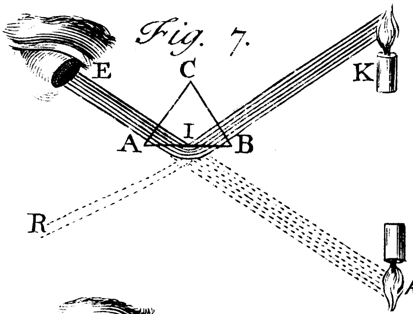

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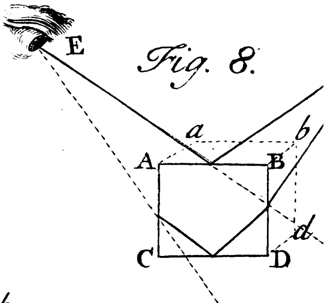

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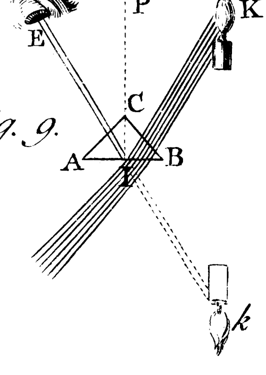

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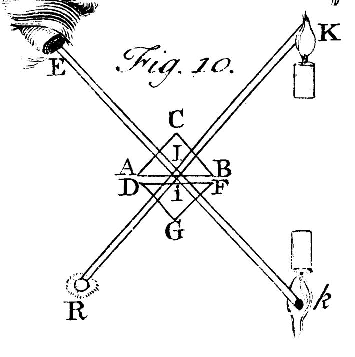

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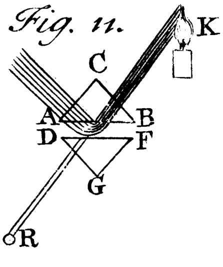

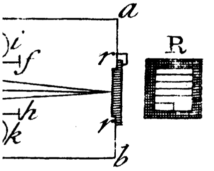

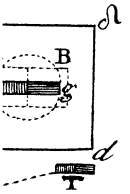

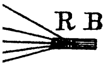

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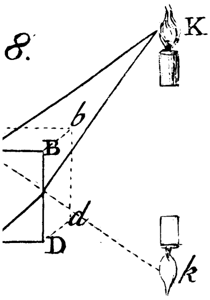

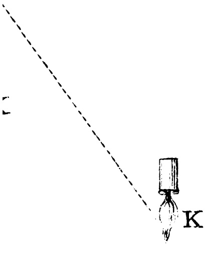

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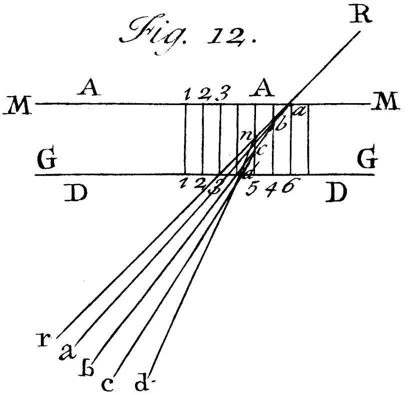

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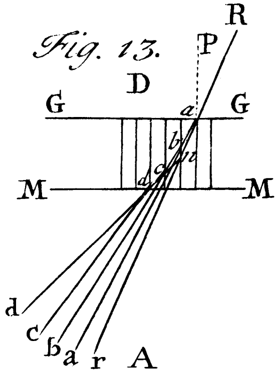

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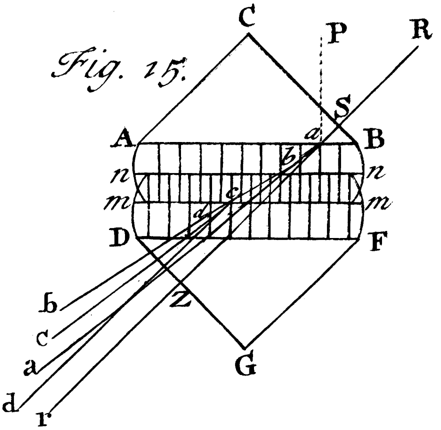

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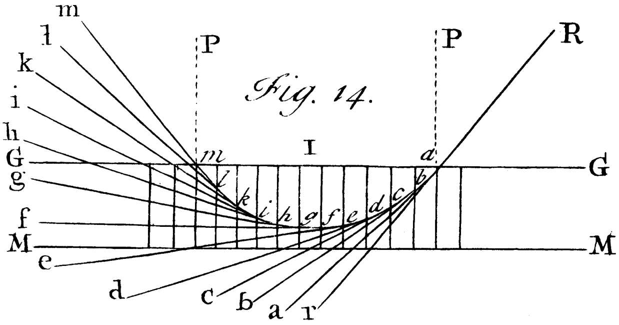

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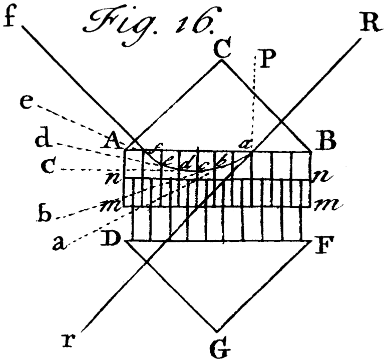

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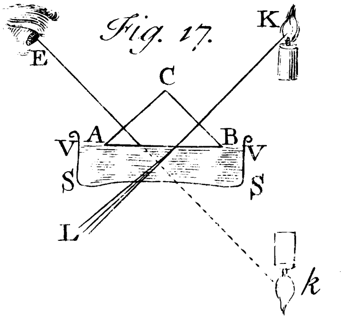

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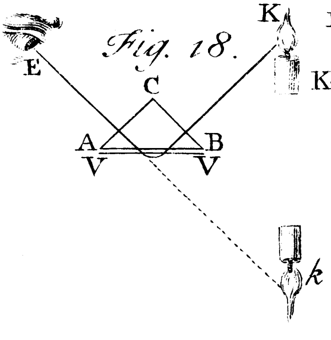

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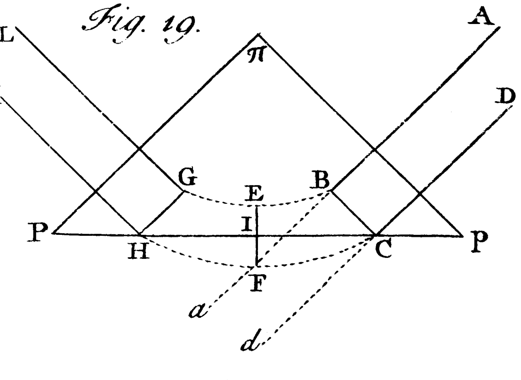

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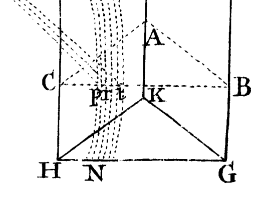

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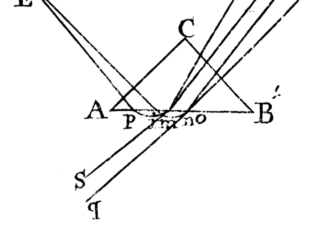

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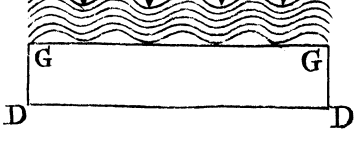

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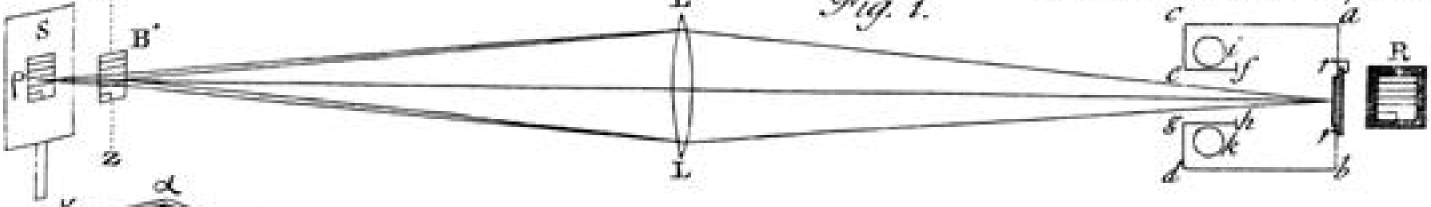

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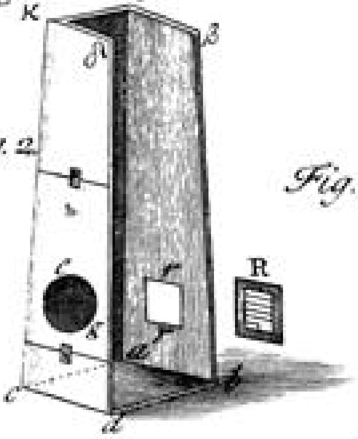

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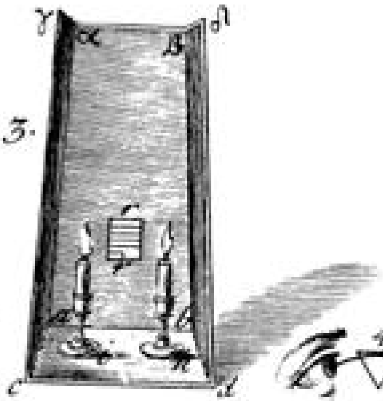

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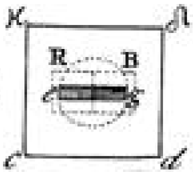

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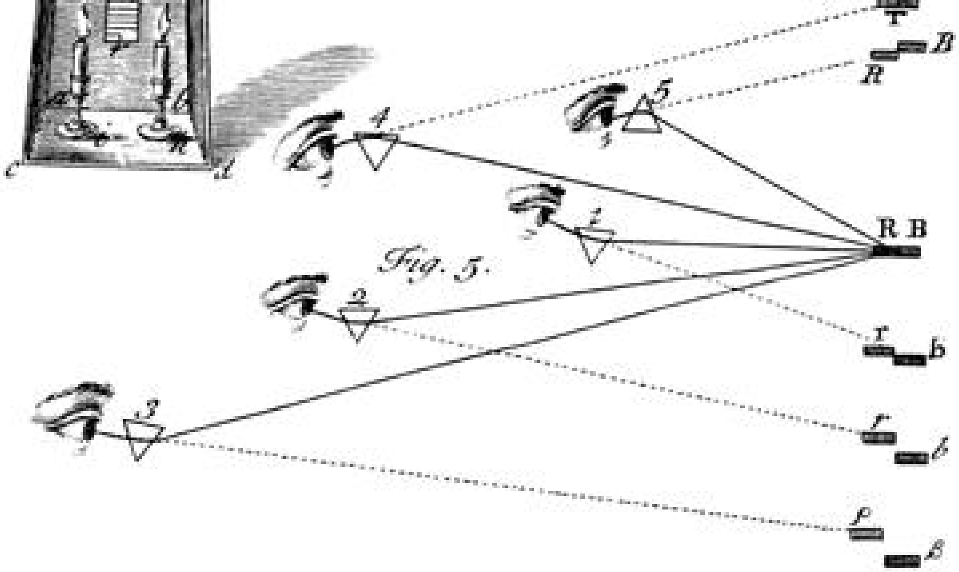

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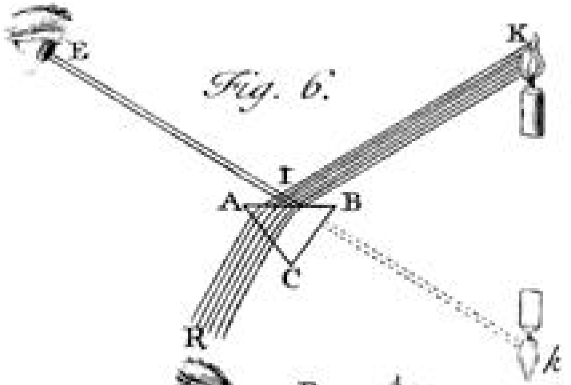

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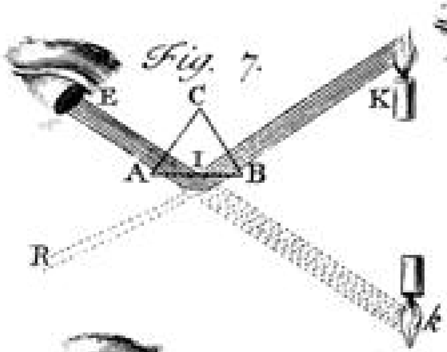

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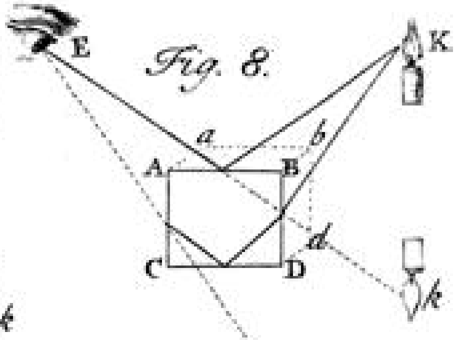

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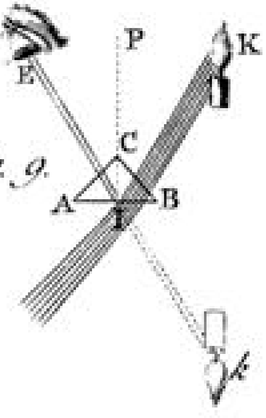

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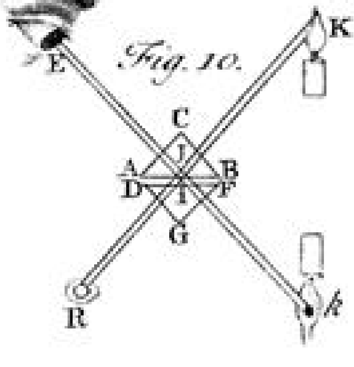

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